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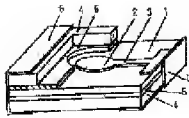
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(54) PIEZOELECTRIC RESONANCE COMPONENT AND MANUFACTURE



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a stable vibration space and an excellent sealing property and to prevent the characteristic degradation of a piezoelectric resonator due to the exudation of a resin layer.

SOLUTION: In the case of manufacturing this piezoelectric resonance component constituted by holding the piezoelectric resonator 1 for which a vibration electrode 2 for vibration excitation and a pull-out electrode 3 are installed on two main surfaces by at least two sealing plates 4 for protecting the main surfaces of the piezoelectric resonator 1 and laminating them by the method, the resin layer 5 whose main component is thermosetting resin for which a glass transition temperature after setting is higher than 100°C is formed by printing so as to form the vibration space in an area near the vibration electrode on the surface in contact with the piezoelectric resonator 1 of the sealing plate 4 first. Then, the resin layer 5 is turned to a semi-set state. Thereafter, the piezoelectric resonator 1 is held by the sealing plates 4 so as to make the vibration space formation surface of the sealing plate 4 where the resin layer 5 in a semi-set state is formed and the vibration electrode 2 of the piezoelectric resonator 1 face each other. Then, the resin layer 5 in the semi-set state is truly set.

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CLAIMS

[Claim(s)]

[Claim 1] In the piezo-electric resonance components which put and carried out
the laminating of the piezo resonator which is pulled out with the vibrating
electrode for oscillating excitation, and by which the electrode is installed in two
principal planes, and constituted it from at least two closure plates for protecting
the principal plane of said piezo resonator The piezo-electric resonance
components characterized by forming oscillating space in said field near the

vibrating electrode by making the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more intervene between said closure plates and said piezo resonators.

[Claim 2] The piezo-electric resonance component according to claim 1 with which the thickness range of said resin layer is characterized by 10-micrometer or more being 100 micrometers or less.

[Claim 3] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates for protecting the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which forms the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more by printing, Before the process which changes said resin layer into a semi-hardening condition, and the resin layer of said semi-hardening condition are formed, so that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate, and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 4] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates for protecting the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode

at the principal plane of said piezo resonator The process which forms the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more by printing except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by having the process which changes said resin layer into a semi-hardening condition, the process which pinches said piezo resonator by which the resin layer of said semi-hardening condition was formed in two principal planes with said closure plate, and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 5] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which forms the 1st resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more by printing except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the vibrating electrode The process which forms the 2nd resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more by printing, The principal plane of the process which changes the said 1st and 2nd resin layer into a semi-hardening condition, and another side which does not form said 1st resin layer of said piezo resonator by printing, and the field which forms said 2nd resin layer of said 1st closure plate by printing face. And while forms said 1st resin layer of said piezo resonator by printing, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said

piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of said 1st [the] of said semi-hardening condition, and the 2nd resin layer.

[Claim 6] The manufacture approach of a piezo-electric resonance component according to claim 3, 4, or 5 that the thickness range is characterized by forming 10-micrometer or more resin layer 100 micrometers or less by printing.

[Claim 7] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more], or semi-hardening, So that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face before said resin film laminates The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate, and the process which carries out actual hardening of said resin film.

[Claim 8] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at the principal plane of said piezo resonator The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100

degrees C or more], or semi-hardening except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by equipping two principal planes with the process which pinches said piezo resonator which said resin film laminated with said closure plate, and the process which carries out actual hardening of said resin film.

[Claim 9] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which laminates the 1st resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more], or semi-hardening except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the vibrating electrode The process which laminates the 2nd resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more], or semi-hardening, The principal plane of another side which does not laminate said 1st resin film of said piezo resonator, and the field which laminates said 2nd resin film of said 1st closure plate face. And while laminates said 1st resin film of said piezo resonator, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of the said 1st and 2nd resin film.

[Claim 10] The manufacture approach of a piezo-electric resonance component

according to claim 7, 8, or 9 that the thickness range is characterized by laminating 10-micrometer or more resin film 100 micrometers or less.

[Claim 11] In the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator The piezo-electric resonance components characterized by making the resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s intervene between said closure plates and said piezo resonators, and forming oscillating space in said field near the vibrating electrode of said piezo resonator.

[Claim 12] The piezo-electric resonance component according to claim 11 with which the thickness range of a resin layer is characterized by 10-micrometer or more being 100 micrometers or less.

[Claim 13] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which forms the resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing, Before the process which changes said resin layer into a semi-hardening condition, and the resin layer of said semi-hardening condition are formed, so that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate,

and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 14] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at the principal plane of said piezo resonator The process which forms the resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by having the process which changes said resin layer into a semi-hardening condition, the process which pinches said piezo resonator by which the resin layer of said semi-hardening condition was formed in two principal planes with said closure plate, and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 15] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which forms the 1st resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the vibrating electrode The

process which forms the 2nd resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing, The principal plane of the process which changes the said 1st and 2nd resin layer into a semi-hardening condition, and another side which does not form said 1st resin layer of said piezo resonator by printing, and the field which forms said 2nd resin layer of said 1st closure plate by printing face. And while forms said 1st resin layer of said piezo resonator by printing, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of said 1st [the] of said semi-hardening condition, and the 2nd resin layer, and forming the piezo-electric resonance components of a laminated structure.

[Claim 16] The manufacture approach of a piezo-electric resonance component according to claim 13, 14, or 15 that thickness of a resin layer is characterized by forming by printing in [10 micrometer or more] 100 micrometers or less.

[Claim 17] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening, So that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face before said resin film laminates The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate,

and the process which carries out actual hardening of said resin film, and forming the piezo-electric resonance components of a laminated structure.

[Claim 18] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at the principal plane of said piezo resonator The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by equipping two principal planes with the process which pinches said piezo resonator which said resin film laminated with said closure plate, and the process which carries out actual hardening of said resin film, and forming the piezo-electric resonance components of a laminated structure.

[Claim 19] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which laminates the 1st resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the

vibrating electrode The process which laminates the 2nd resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening, The principal plane of another side which does not laminate said 1st resin film of said piezo resonator, and the field which laminates said 2nd resin film of said 1st closure plate face. And while laminates said 1st resin film of said piezo resonator, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of the said 1st and 2nd resin film, and forming the piezo-electric resonance components of a laminated structure.

[Claim 20] The manufacture approach of a piezo-electric resonance component according to claim 17, 18, or 19 that the thickness range is characterized by laminating 10-micrometer or more resin film 100 micrometers or less.

[Claim 21] The manufacture approach of the piezo-electric resonance component according to claim 13, 14, 15, 17, 18, or 19 characterized by carrying out actual hardening under pressurization 10kg/cm² or less.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the piezo-electric resonance component which carried out the laminating of the piezo resonator with the closure plate, and its manufacture approach.

[0002]

[Description of the Prior Art] The piezo-electric resonance components known conventionally carry out the laminating of the piezo resonator which it pulls out with the electrode of a specific pattern to two principal planes of a piezo resonator, and an electrode is formed, and changes between two closure plates with which the crevice is formed in the side which faces a piezo resonator, and constitute it by forming an external electrode in **** of this layered product as indicated by JP,2-309707,A etc. The example of structure of such piezo-electric resonance components is shown in drawing 17 .

[0003] Drawing 17 is a decomposition perspective view in front of the laminating of a piezo resonator and a closure plate. The piezo resonator, the vibrating electrode with which 21 was formed in 22 and 23 were formed in the principal plane in this drawing, respectively, and the drawer electrode are installed. It is a closure plate, and the crevice is formed in the side which faces a piezo resonator 21, and 24 applies the resin layer 25 to the crevice periphery, and pastes up with a piezo resonator 21.

[0004] Drawing 18 (a) carries out the laminating of the piezo resonator 21 between two closure plates 24, and expresses the condition of having formed the external electrode. Moreover, drawing 18 (b) is a fragmentary sectional view [in / to drawing 18 (a) / an A-A side]. Thus, space is secured so that vibration by the vibrating electrode 22 on a piezo resonator 21 may not be checked by the crevice and the resin layer 25 of the closure plate 24.

[0005]

[Problem(s) to be Solved by the Invention] However, since the conventional piezo-electric resonance components have pasted up the closure plate 24 and the piezo resonator 21 in the resin layer 25, they have the fault of the adhesive property of the closure plate 24 and a piezo resonator 21 falling by the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), and reducing the sealing performance of oscillating space.

[0006] Moreover, when heat and a pressure are applied at the process which carries out actual hardening, the resin layer 25 flows in a hardening process, and there is also a fault of a resin layer oozing out, barring vibration and degrading the property of a piezo resonator in the vibrating electrode side of a piezo resonator.

[0007] This invention aims at offering the piezo-electric resonance component which the stable oscillating space and good sealing performance are acquired in consideration of the technical problem of such a conventional approach, and can prevent property degradation of the piezo resonator by the exudation of a resin layer, and its manufacture approach.

[0008]

[Means for Solving the Problem] In the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which pulls out this invention with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates for protecting the principal plane of said piezo resonator They are the piezo-electric resonance components characterized by forming oscillating space in said field near the vibrating electrode by making the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more intervene between said closure plates and said piezo resonators.

[0009]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using drawing 5 from drawing 1 .

[0010] (Gestalt 1 of operation) The 1st gestalt about the piezo-electric resonance components of this invention is explained using drawing 1 and drawing 2 . In this drawing, the resin layer in which in a piezo resonator and 2 a drawer electrode and 4 formed the closure plate in, and, as for 5, a vibrating electrode and 3 formed [1] the oscillating space of a piezo resonator 1, and 6 are external electrodes.

[0011] Drawing 1 is claim 1 of this invention, and the notching perspective view of a piezo-electric resonance component according to claim 2. Drawing 2 (a) is the perspective view of piezo-electric resonance components, and drawing 2 (b) is a fragmentary sectional view in the A-A side of drawing 2 (a). A piezo resonator consists of piezo-electric ceramic ingredients, such as PZT, and pulls out with a vibrating electrode 2, and an electrode 3 is formed by the dry type forming-membranes methods, such as the sputtering method. If an electrical potential difference is impressed to a vibrating electrode 2 from the exterior, the oscillation mode to which it vibrates only near the vibrating electrode 2 will be excited. The resin layer 5 is installed between the piezo resonator 1 and the closure plate 4, and oscillating space is formed so that vibration of a piezo resonator 1 may not be checked. The closure plate 4 consists of ingredients, such as an alumina, and a dielectric ceramic or resin. As for the resin layer 5, glass transition temperature is using thermosetting resin, such as 100 degrees C or more, for example, epoxy etc., as the principal component. However, although thermoplastics, filler-like glass, etc. may be added as an accessory constituent if needed, the addition and class are adjusted so that the glass transition temperature as resin mixture may become 100 degrees C or more. in addition, the glass transition temperature of the thermosetting resin which constitutes the resin layer 5 -- TMA -- it asks using thermal analysis, such as law. The drawer electrode 3 is electrically connected with the external electrode 6 in the end face by two places shown by B of drawing 2 (b). The external electrode 6 is formed by the dry type forming-membranes methods, such as the wet forming-membranes methods, such as the galvanizing method, or the sputtering method. By the configuration mentioned

above, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), this invention can prevent the adhesive fall of the closure plate 4 and a piezo resonator 1, and can acquire the sealing performance of sufficient oscillating space. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of the resin layer 5 has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0012] (Gestalt 2 of operation) The 2nd gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 3 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin layers in which a drawer electrode and 4 formed the closure plate in, and 5 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 3 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 3 (b), except for the field near the vibrating electrode of a piezo resonator, resin is printed on the front face of the closure plate 4 which consists of ingredients, such as an alumina, and a dielectric ceramic or resin, by screen-stencil, and the resin layer 5 is formed in it. As for this resin, a principal component 100 degrees C or more uses [the glass transition temperature after hardening] thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Next, the closure plate 4 in which the resin layer 5 was formed is heated, and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 3 (c), a piezo resonator is laid on the closure plate in which the resin layer 5 was

formed, and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 2nd, since glass transition temperature has pasted up the closure plate and the piezo resonator with resin 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0013] (Gestalt 3 of operation) The 3rd gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 4 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin layers in which a drawer electrode and 4 formed the closure plate in, and 5 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 4 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 4 (b), except for the field near the vibrating electrode, resin is

printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. Next, except for the field near the vibrating electrode, resin is printed to the remaining principal plane of a piezo resonator by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. The resin with which the glass transition temperature after hardening uses thermosetting resin 100 degrees C or more as a principal component is used for this resin. In addition, TMA after glass transition temperature stiffened resin -- it asks by law. Next, the piezo resonator in which the resin layer 5 was formed is heated, and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 4 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin layer was formed, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 3rd, since glass transition temperature has pasted up the closure plate and the piezo resonator with resin 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of the resin layer 5 has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this

operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0014] (Gestalt 4 of operation) The 3rd gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 5 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin layers in which a drawer electrode and 4 formed the closure plate in, and 5 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 5 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 5 (b), except for the field near the vibrating electrode, resin is printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. Next, as shown in drawing 5 (c), except for the field near the vibrating electrode, resin is printed on one side of a closure plate by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. The resin with which the glass transition temperature after hardening uses thermosetting resin 100 degrees C or more as a principal component is used for this resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Next, the piezo resonator and the closure plate in which the resin layer was formed are heated, and are changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, it lays by turning up the field where the resin layer 5 was formed in the piezo resonator on the closure plate in which the resin layer 5 was formed as shown in drawing 5 (d), and the closure plate 4 of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next,

chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 4th, since glass transition temperature has pasted up the closure plate 4 and the piezo resonator 1 with resin 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of the resin layer 5 has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0015] (Gestalt 5 of operation) The 5th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 6 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin film layers in which a drawer electrode and 4 formed the closure plate in, and 7 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 6 R> 6 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 6 (b), except for the field near the vibrating electrode of a piezo resonator, the resin film of un-hardening or semi-hardening is laminated on the front face of the closure plate 4 which consists of ingredients, such as an alumina,

and a dielectric ceramic or resin, and the resin film layer 7 is formed in it. As for this resin film, the principal component 100 degrees C or more is constituted for the glass transition temperature after hardening by thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm² with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 6 (c), a piezo resonator is laid on the closure plate in which the resin film layer 7 was formed, and the closure plate 4 of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin film is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 5th, since glass transition temperature has pasted up the closure plate and the piezo resonator with the resin film 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0016] (Gestalt 6 of operation) The 6th gestalt about the manufacture approach

of the piezo-electric resonance components of this invention is explained using drawing 7 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin film layers in which a drawer electrode and 4 formed the closure plate in, and 7 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 7 R> 7 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 7 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and the resin film layer 7 is formed in it. Next, except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in the remaining principal plane of a piezo resonator, and a resin film layer is formed in it. As for this resin film, the principal component 100 degrees C or more is constituted for the glass transition temperature after hardening by thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm² with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 7 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin film layer 7 was formed, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin film is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 6th, since glass transition temperature has pasted up the

closure plate and the piezo resonator with the resin film 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0017] (Gestalt 7 of operation) The 7th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 8 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin film layers in which a drawer electrode and 4 formed the closure plate in, and 7 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 8 R> 8 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 8 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and a resin film layer is formed in it. Next, as shown in drawing 8 (c), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated on one side of a closure plate, and the resin film layer 7 is formed in it. As for this resin film, the principal component 100 degrees C or more is constituted for the glass transition temperature after hardening by thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm² with the

temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, it lays by turning up the field where the resin film layer was formed in the piezo resonator on the closure plate in which the resin film layer was formed as shown in drawing 8 (d), and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 7th, since glass transition temperature has pasted up the closure plate and the piezo resonator with the resin film 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0018] (Gestalt 8 of operation) The 8th gestalt about the piezo-electric resonance components of this invention is explained using drawing 9 and drawing 10 . In this drawing, the resin layer in which in a piezo resonator and 12 a drawer electrode and 14 formed the closure plate in, and, as for 15, a vibrating electrode and 13 formed [11] the oscillating space of a piezo resonator 11, and 16 are external electrodes. Drawing 9 is the notching perspective view of the piezo-

electric resonance components of this invention. Drawing 10 (a) is the perspective view of piezo-electric resonance components, and drawing 10 (b) is a fragmentary sectional view in the A-A side of drawing 10 (a). A piezo resonator consists of piezo-electric ceramic ingredients, such as PZT, and pulls out with a vibrating electrode 12, and an electrode 13 is formed by the dry type forming-membranes methods, such as the sputtering method. If an electrical potential difference is impressed to a vibrating electrode 12 from the exterior, the oscillation mode to which it vibrates only near the vibrating electrode 12 will be excited. The resin layer 15 is installed between the piezo resonator 11 and the closure plate 14, and oscillating space is formed so that vibration of a piezo resonator 11 may not be checked. The closure plate 14 consists of ingredients, such as an alumina, and a dielectric ceramic or resin. As for the resin layer 15, the minimum melt viscosity at the time of heat hardening is using thermosetting resin, such as 20 or more Pa-s, for example, epoxy etc., as the principal component. However, although thermoplastics, filler-like glass, etc. may be added as an accessory constituent if needed, the addition and class are adjusted so that the minimum melt viscosity at the time of the heat hardening as resin mixture may become 20Pa and more than s. In addition, it asks for the minimum melt viscosity of the thermosetting resin which constitutes the resin layer 15 using a rheometer. The drawer electrode 13 is electrically connected with the external electrode 16 in the end face by two places shown by B of drawing 10 (b). The external electrode 16 is formed by the dry type forming-membranes methods, such as the wet forming-membranes methods, such as the galvanizing method, or the sputtering method. By the configuration mentioned above, when heat and a pressure are applied at the process which carries out actual hardening, the resin layer 15 flows in a hardening process, and to the vibrating electrode side of a piezo resonator, a resin layer can ooze out, and this invention can bar vibration, can solve the technical problem that the property of a piezo resonator is degraded, and can acquire high-reliability and the stable property. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100

micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 8 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0019] (Gestalt 9 of operation) The 9th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 11 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin layers in which a drawer electrode and 14 formed the closure plate in, and 15 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 11 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 12, and an electrode 13 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 11 (b), except for the field near the vibrating electrode of a piezo resonator, resin is printed on the front face of the closure plate 14 which consists of ingredients, such as an alumina, and a dielectric ceramic or resin, by screen-stencil, and the resin layer 15 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Next, the closure plate in which the resin layer was formed is heated and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 11 (c), a piezo resonator is laid on the closure plate in which the resin layer was formed, and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm², since the resin layer oozed

out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 9th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 9 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0020] (Gestalt 10 of operation) The 10th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 12 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin layers in which a drawer electrode and 14 formed the closure plate in, and 15 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 12 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 12 (b), except for the field near the vibrating electrode, resin is

printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. Next, except for the field near the vibrating electrode, resin is printed to the remaining principal plane of a piezo resonator by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Next, the piezo resonator in which the resin layer was formed is heated and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 12 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin layer was formed, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm², since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric

resonance components concerning the operation gestalt of the above 10th .

Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 10 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0021] (Gestalt 11 of operation) The 11th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 13 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin layers in which a drawer electrode and 14 formed the closure plate in, and 15 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 13 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 13 (b), except for the field near the vibrating electrode, resin is printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. Next, as shown in drawing 13 (c), except for the field near the vibrating electrode, resin is printed on one side of a closure plate by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tack nature is lost. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Next, the piezo resonator and the closure plate in which the resin layer was formed are heated, and are changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, it lays by turning up the field where the resin layer was

formed in the piezo resonator on the closure plate in which the resin layer was formed as shown in drawing 13 (d), and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm², since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 11th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 11 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0022] (Gestalt 12 of operation) The 12th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 14 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin film layers in which a

drawer electrode and 14 formed the closure plate in, and 17 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 14 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 12, and an electrode 13 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 14 (b), except for the field near the vibrating electrode of a piezo resonator, the resin film of un-hardening or semi-hardening is laminated on the front face of the closure plate 14 which consists of ingredients, such as an alumina, and a dielectric ceramic or resin, and the resin film layer 17 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin film. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm² with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 14 (c), a piezo resonator is laid on the closure plate in which the resin film layer was formed, and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm², since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat

and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 12th .

Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 12 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0023] (Gestalt 13 of operation) The 13th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 15 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin film layers in which a drawer electrode and 14 formed the closure plate in, and 17 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 15 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 12, and an electrode 13 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 15 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and the resin film layer 17 is formed in it. Next, except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in the remaining principal plane of a piezo resonator, and the resin film layer 17 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin film. In addition, it asks for the minimum melt viscosity of

thermosetting resin using a rheometer. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm² with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 15 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin film layer was formed, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin film is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm², since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 13th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 13 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0024] (Gestalt 14 of operation) The 7th gestalt about the manufacture approach

of the piezo-electric resonance components of this invention is explained using drawing 16 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin film layers in which a drawer electrode and 14 formed the closure plate in, and 17 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 16 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 16 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and the resin film layer 17 is formed in it. Next, as shown in drawing 16 (c), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated on one side of a closure plate, and the resin film layer 17 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin film. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm² with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, it lays by turning up the field where the resin film layer was formed in the piezo resonator on the closure plate in which the resin film layer was formed as shown in drawing 16 (d), and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm² pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm², since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry

type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 14th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 14 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0025] In addition, in order to check the effectiveness of the gestalt of operation of this invention described above, when it experimented in sealing performance about what various glass transition temperature was changed and was created, the result of Table 1 was obtained.

[0026]

[Table 1]

ガラス転移温度 (°C)	50	70	90	105	125	140
密封性	NG	NG	NG	G	G	G

[0027] It turns out that the sealing performance of a case with a glass transition temperature of 100 degrees C or more is high so that clearly from Table 1.

[0028] Moreover, about what various the minimum melt viscosity was changed

and was created, when [the] it permeated and the broth multiplier was measured, the result as shown in Table 2 was obtained.

[0029]

[Table 2]

最低熔融粘土 (Pa・S)	5	10	20	30	50	100
浸みだし係数 注(1)	>10	>10	<3	<2	<2	<2
判定	NG	NG	G	G	G	G

注(1) 浸みだし係数=浸みだし幅÷樹脂層厚み

[0030] When the minimum melt viscosity is 20 or more so that clearly from Table 2, it turns out that it permeates and a result with a sufficient broth multiplier is shown. In addition, a broth multiplier permeates, is expressed with broth multiplier =(permeating broth width of face)/(resin thickness), and it permeates and it is [it permeates and] this amount defined by that condition as shows broth width of face and resin thickness to drawing 19 .

[0031]

[Effect of the Invention] Since glass transition temperature has pasted up the closure plate and the piezo resonator with resin or a resin film 100 degrees C or more as mentioned above according to this invention, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired.

[0032] Moreover, since the minimum melt viscosity at the time of heat hardening has pasted up the closure plate and the piezo resonator with the resin or the resin film 20Pa and more than s, when heat and a pressure are applied at the process which carries out actual hardening, the resin layer 15 flows in a hardening process, to the vibrating electrode side of a piezo resonator, a resin layer can ooze out, vibration can be barred, the technical problem that the

property of a piezo resonator is degraded can be solved, and high-reliability and the stable property can be acquired.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The notching perspective view of the piezo-electric resonance components in the gestalt 1 of operation of this invention

[Drawing 2] For (a), the perspective view of the piezo-electric resonance components in the gestalt 1 of this operation and (b) are a fragmentary sectional view in the A-A side of drawing 2 (a).

[Drawing 3] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 2 of operation of this invention

[Drawing 4] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 3 of operation of this invention

[Drawing 5] The piezo-electricity in the gestalt 4 of operation of this invention is a decomposition perspective view in front of the laminating of *****.

[Drawing 6] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 5 of operation of this invention

[Drawing 7] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 6 of operation of this invention

[Drawing 8] The piezo-electricity in the gestalt 7 of operation of this invention is a decomposition perspective view in front of the laminating of *****.

[Drawing 9] The notching perspective view of the piezo-electric resonance components in the gestalt 8 of operation of this invention

[Drawing 10] For (a), the perspective view of the piezo-electric resonance components in the gestalt 8 of this operation and (b) are a fragmentary sectional view in the A-A side of drawing 10 (a).

[Drawing 11] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 9 of operation of this invention

[Drawing 12] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 10 of operation of this invention

[Drawing 13] The piezo-electricity in the gestalt 11 of operation of this invention is a decomposition perspective view in front of the laminating of *****.

[Drawing 14] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 12 of operation of this invention

[Drawing 15] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 13 of operation of this invention

[Drawing 16] The piezo-electricity in the gestalt 14 of operation of this invention is a decomposition perspective view in front of the laminating of *****.

[Drawing 17] The decomposition perspective view in front of the laminating of the

conventional piezo-electric resonance components

[Drawing 18] (a) is the perspective view of the conventional piezo-electric resonance components, and (b) is a fragmentary sectional view in the A-A side of drawing 18 (a).

[Drawing 19] The drawing which is used when confirming the effectiveness of the minimum melt viscosity in the gestalt of operation of this invention and in which is permeated and a broth multiplier is shown

(Explanation of a sign)

1 Piezo Resonator

2 Vibrating Electrode

3 Drawer Electrode

4 Closure Plate

5 Resin Layer

6 External Electrode

11 Piezo Resonator

12 Vibrating Electrode

13 Drawer Electrode

14 Closure Plate

15 Resin Layer

16 External Electrode

17 Resin Film Layer

21 Piezo Resonator

22 Vibrating Electrode

23 Drawer Electrode

24 Closure Plate

25 Resin

26 External Electrode

[Translation done.]

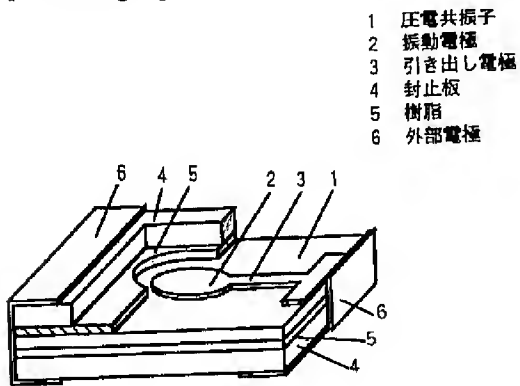
* NOTICES *

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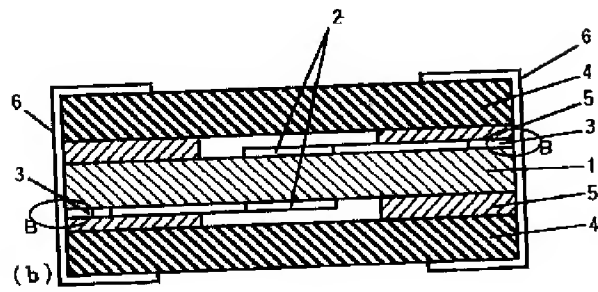
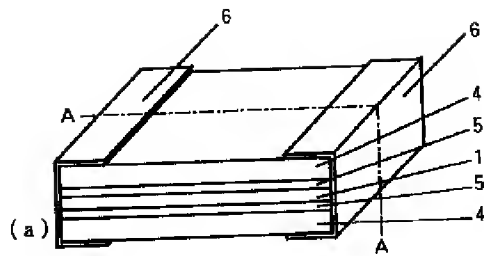
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DRAWINGS

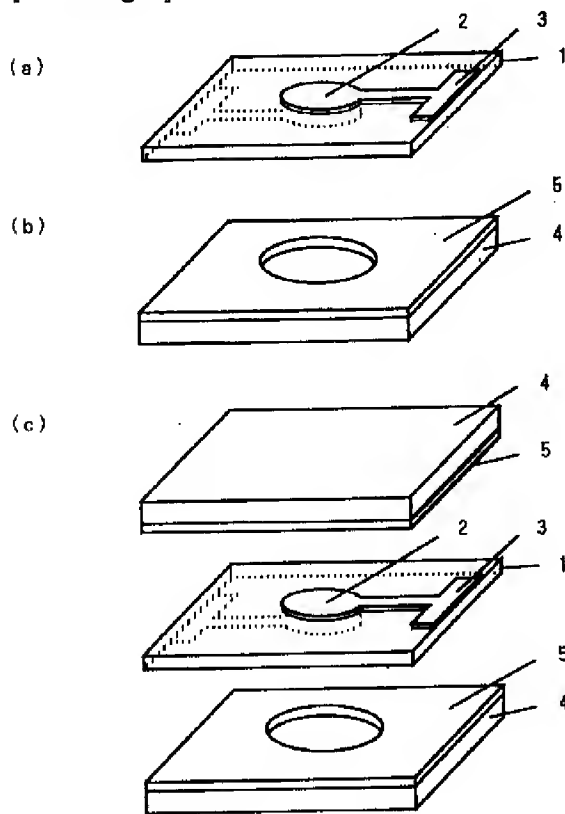
[Drawing 1]



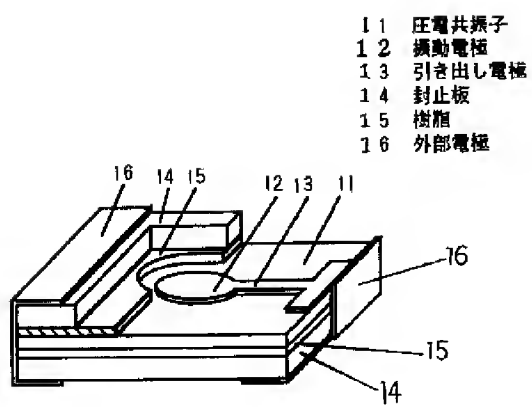
[Drawing 2]



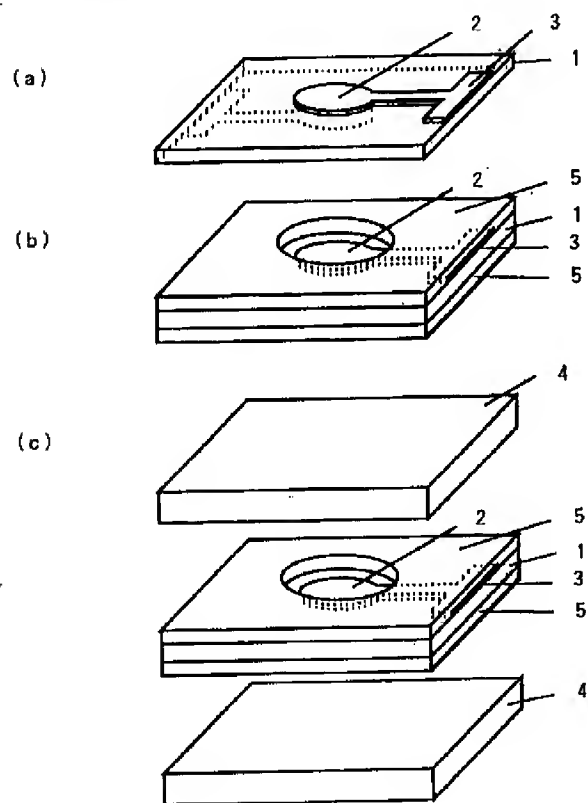
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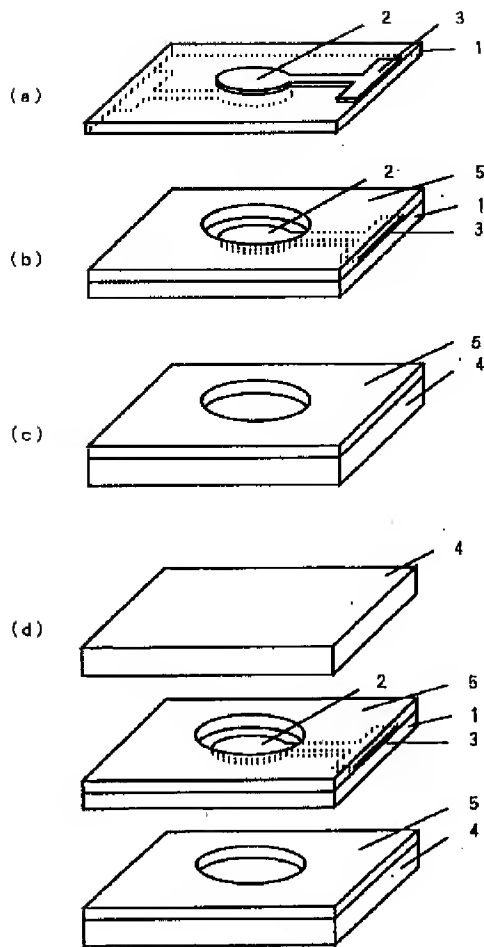
[Drawing 9]



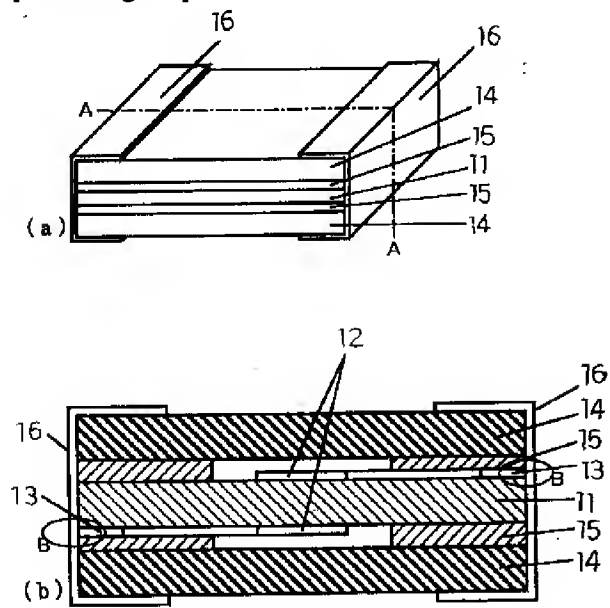
[Drawing 4]



[Drawing 5]

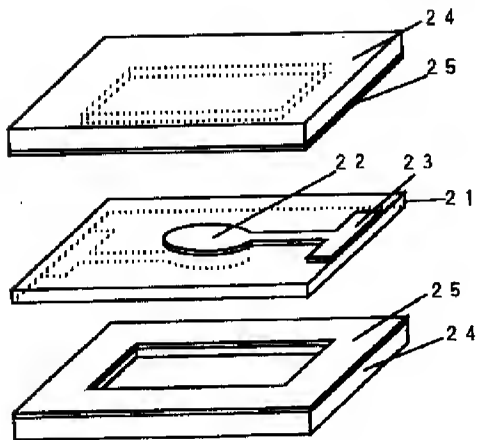


[Drawing 10]

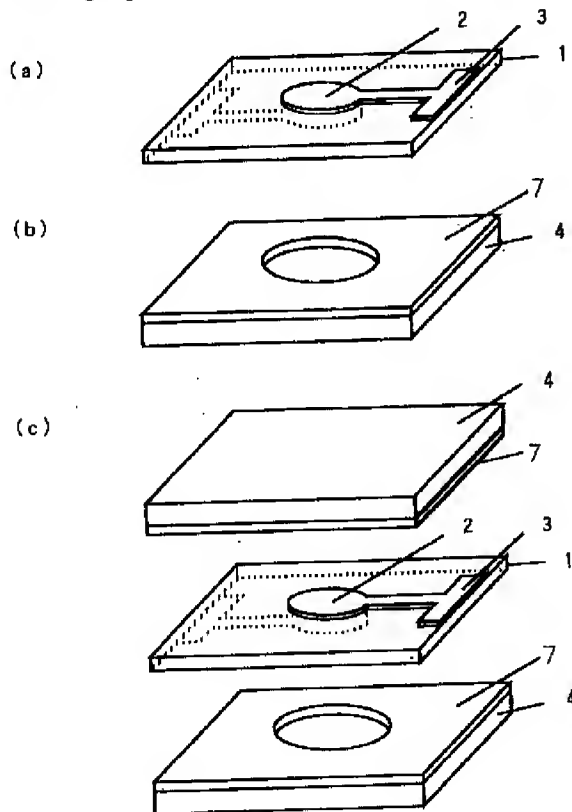


[Drawing 17]

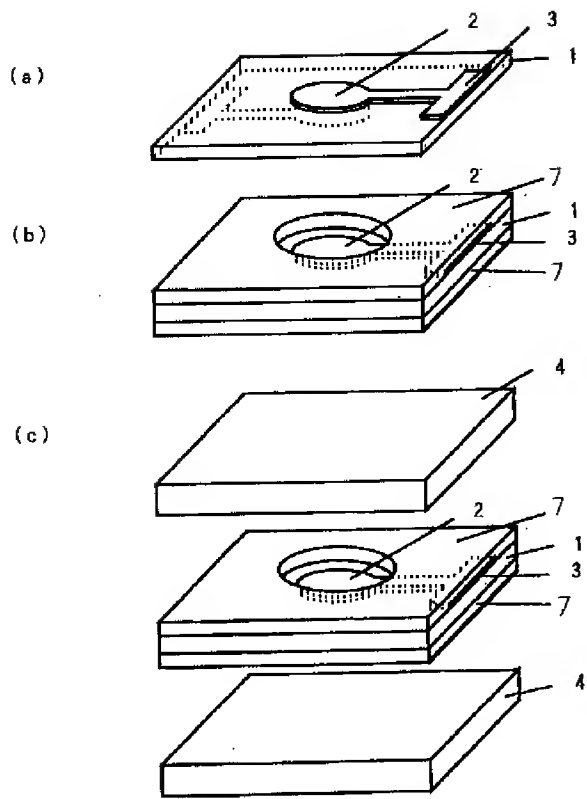
- 2 1 圧電共振子
- 2 2 振動電極
- 2 3 引き出し電極
- 2 4 封止板
- 2 5 樹脂



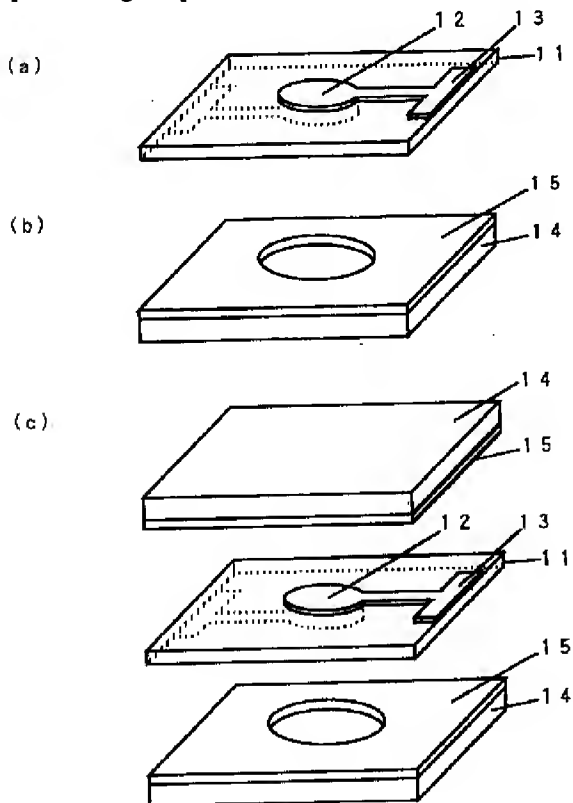
[Drawing 6]



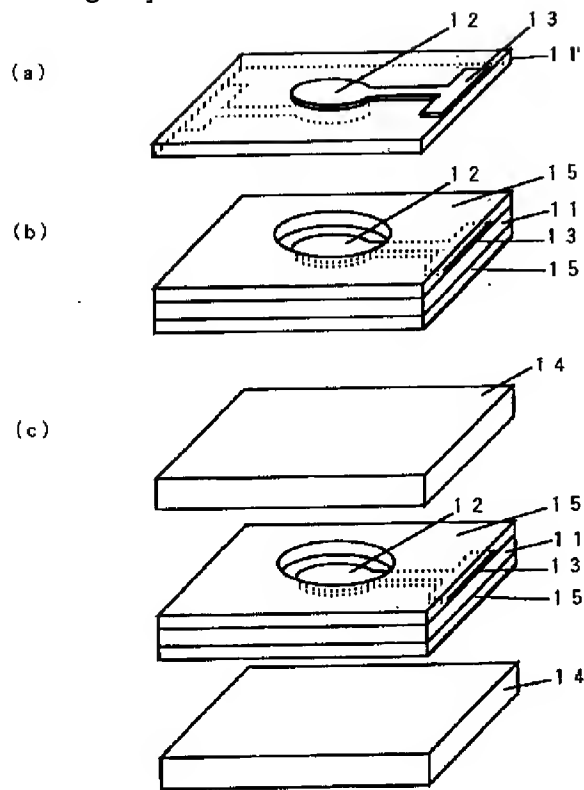
[Drawing 7]



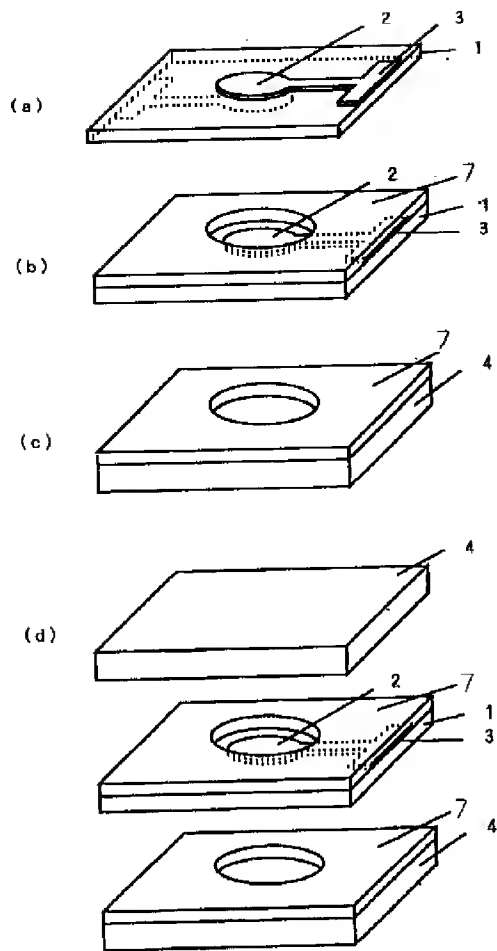
[Drawing 11]



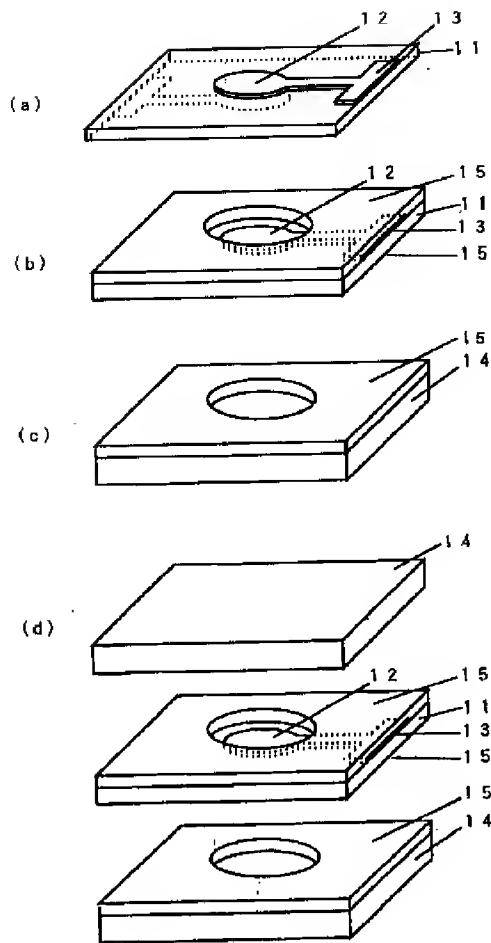
[Drawing 12]



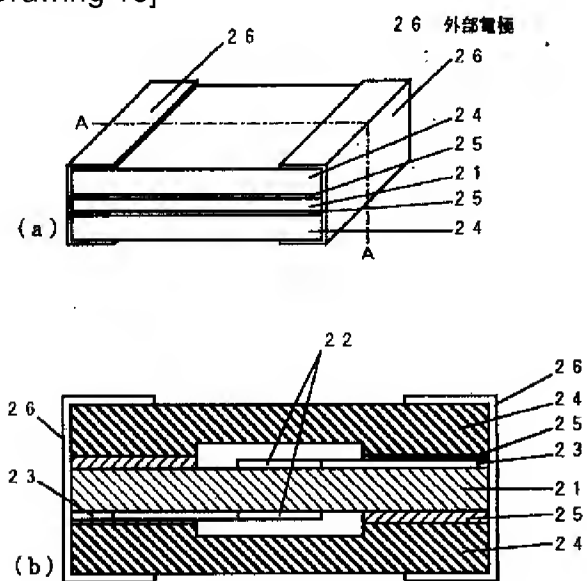
[Drawing 8]



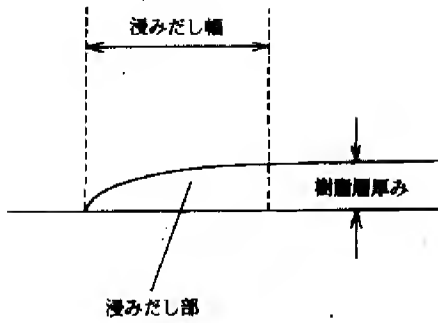
[Drawing 13]



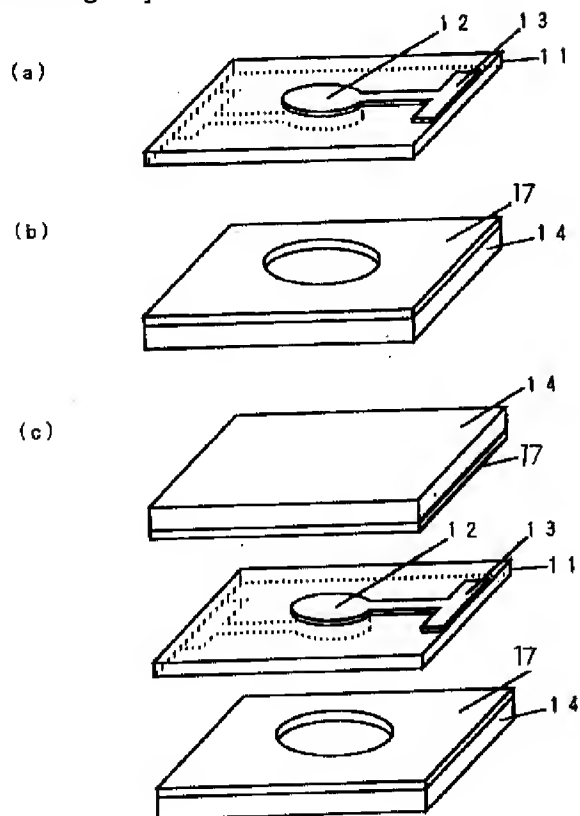
[Drawing 18]



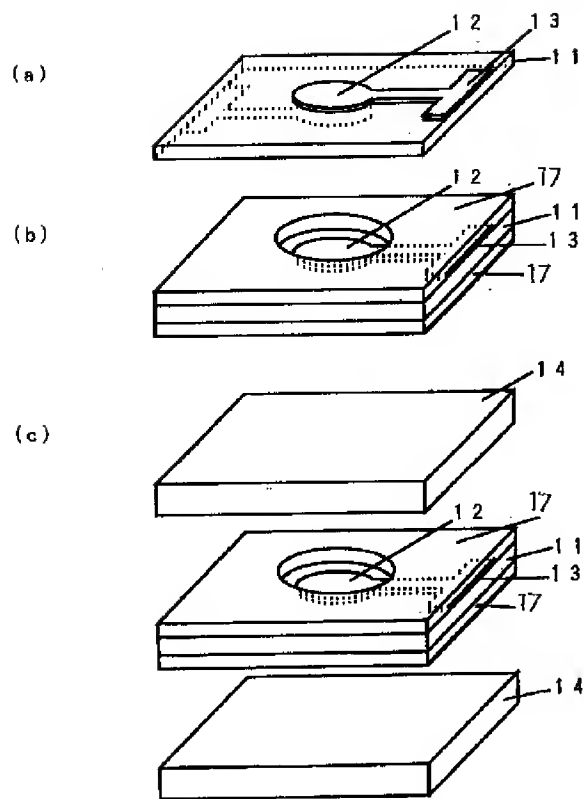
[Drawing 19]



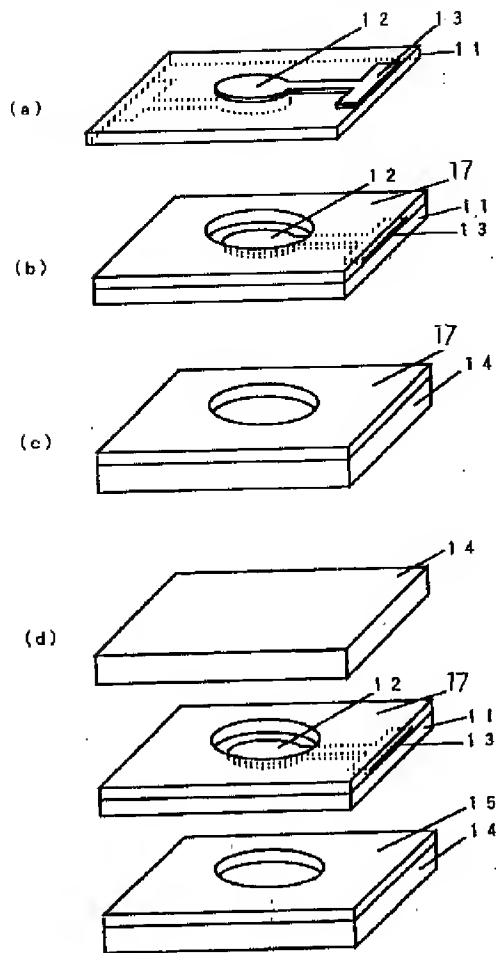
[Drawing 14]



[Drawing 15]



[Drawing 16]



[Translation done.]

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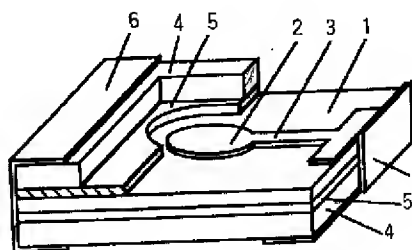
(54) 【発明の名称】 圧電共振部品と製造方法

(57) 【要約】

【課題】 封止板と圧電共振子を樹脂で接着しているため、使用環境内の温度変化により封止板と圧電共振子の接着性が低下する。

【解決手段】 振動励振用の振動電極2と引き出し電極3が2つの主面に設置されている圧電共振子1を、圧電共振子1の主面を保護するための少なくとも2枚の封止板4で挟み込んで積層して構成した圧電共振部品の製造方法において、封止板4の圧電共振子1と接する面に、振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする樹脂層5を印刷により形成する工程と、樹脂層5を半硬化状態にする工程と、半硬化状態の樹脂層5が形成された前記封止板4の振動空間形成面と、圧電共振子1の振動電極2とが相対するように、圧電共振子1を封止板4で挟持する工程と、半硬化状態の樹脂層5を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

- 1 圧電共振子
- 2 振動電極
- 3 引き出し電極
- 4 封止板
- 5 樹脂
- 6 外部電極



【特許請求の範囲】

【請求項1】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品において、前記封止板と前記圧電共振子の間に、ガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする樹脂層を介在させることによって、前記振動電極近傍領域に振動空間が形成されていることを特徴とする圧電共振部品。

【請求項2】 前記樹脂層の厚み範囲が、10μm以上100μm以下であることを特徴とする請求項1記載の圧電共振部品。

【請求項3】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする樹脂層を印刷により形成する工程と、前記樹脂層を半硬化状態にする工程と、前記半硬化状態の樹脂層が形成された前記封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが対向するように、前記圧電共振子を前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項4】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、ガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする樹脂層を印刷により形成する工程と、前記樹脂層を半硬化状態にする工程と、2つの主面に前記半硬化状態の樹脂層が形成された前記圧電共振子を、前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項5】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第1、第2の2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、ガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする第1の樹脂層を印刷により形成する工程と、前記第1の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、ガラス転移温度が100℃以上である熱硬化

性樹脂を主成分とする第2の樹脂層を印刷により形成する工程と、前記第1、第2の樹脂層を半硬化状態にする工程と、前記圧電共振子の前記第1の樹脂層を印刷により形成していない他方の主面と前記第1の封止板の前記第2の樹脂層を印刷により形成している面とが対向し、かつ前記圧電共振子の前記第1の樹脂層を印刷により形成している一方の主面と第2の封止板とが対向するように、前記圧電共振子を前記第1、第2の封止板で挟持する工程と、前記半硬化状態の前記第1、第2の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項6】 厚み範囲が、10μm以上100μm以下の樹脂層を印刷により形成したことを特徴とする請求項3、4又は5記載の圧電共振部品の製造方法。

【請求項7】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、前記樹脂フィルムがラミネートされた前記封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが対向するように、前記圧電共振子を前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項8】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、硬化後のガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、2つの主面に前記樹脂フィルムがラミネートされた前記圧電共振子を、前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項9】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第1、第2の2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、硬化後のガラス転移温度が100℃以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第1の樹脂フィルムをラミネートする工程と、前記

第1の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が 100°C 以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第2の樹脂フィルムをラミネートする工程と、前記圧電共振子の前記第1の樹脂フィルムをラミネートしていない他方の主面と前記第1の封止板の前記第2の樹脂フィルムをラミネートしている面とが相対し、かつ前記圧電共振子の前記第1の樹脂フィルムをラミネートしている一方の主面と第2の封止板とが相対するように、前記圧電共振子を前記第1、第2の封止板で挟持する工程と、前記第1、第2の樹脂フィルムを本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項10】 厚み範囲が $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下の樹脂フィルムを、ラミネートしたことを特徴とする請求項7、8又は9記載の圧電共振部品の製造方法。

【請求項11】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品において、前記封止板と前記圧電共振子の間に、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする樹脂層を介在させて、前記圧電共振子の前記振動電極近傍領域に振動空間が形成されていることを特徴とする圧電共振部品。

【請求項12】 樹脂層の厚み範囲が、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下であることを特徴とする請求項11記載の圧電共振部品。

【請求項13】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする樹脂層を印刷により形成する工程と、前記樹脂層を半硬化状態にする工程と、前記半硬化状態の樹脂層が形成された前記封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが相対するように、前記圧電共振子を前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項14】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする樹脂層を印刷により

形成する工程と、前記樹脂層を半硬化状態にする工程と、2つの主面に前記半硬化状態の樹脂層が形成された前記圧電共振子を前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項15】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第1、第2の2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする第1の樹脂層を印刷により形成する工程と、前記第1の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする第2の樹脂層を印刷により形成する工程と、前記第1、第2の樹脂層を半硬化状態にする工程と、前記圧電共振子の前記第1の樹脂層を印刷により形成していない他方の主面と前記第1の封止板の前記第2の樹脂層を印刷により形成している面とが相対し、かつ前記圧電共振子の前記第1の樹脂層を印刷により形成している一方の主面と第2の封止板とが相対するように、前記圧電共振子を前記第1、第2の封止板で挟持する工程と、前記半硬化状態の前記第1、第2の樹脂層を本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項16】 樹脂層の厚みが、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下の範囲で印刷により形成したことを特徴とする請求項13、14又は15記載の圧電共振部品の製造方法。

【請求項17】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、前記樹脂フィルムがラミネートされた前記封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが相対するように、前記圧電共振子を前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項18】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも2枚の封止板で挟み

込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、2つの主面に前記樹脂フィルムがラミネートされた前記圧電共振子を前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項19】 振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第1、第2の2枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第1の樹脂フィルムをラミネートする工程と、前記第1の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第2の樹脂フィルムをラミネートする工程と、前記圧電共振子の前記第1の樹脂フィルムをラミネートしていない他方の主面と前記第1の封止板の前記第2の樹脂フィルムをラミネートしている面とが相対し、かつ前記圧電共振子の前記第1の樹脂フィルムをラミネートしている一方の主面と第2の封止板とが相対するように、前記圧電共振子を前記第1、第2の封止板で挟持する工程と、前記第1、第2の樹脂フィルムを本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項20】 厚み範囲が $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下の樹脂フィルムを、ラミネートしたことを特徴とする請求項17、18又は19記載の圧電共振部品の製造方法。

【請求項21】 $10\text{kg}/\text{cm}^2$ 以下の加圧下で本硬化することを特徴とする請求項13、14、15、17、18又は19記載の圧電共振部品の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、圧電共振子を封止板と共に積層した圧電共振部品とその製造方法に関するものである。

【0002】

【従来技術】従来より知られている圧電共振部品は、特開平2-309707号公報等に開示されているように、圧電共振子の2つの主面に特定パターンの電極と引き出し電極が形成されて成る圧電共振子を、圧電共振子

に面する側に凹部が形成されている2つの封止板間に積層して、この積層体の端面に外部電極を形成することによって構成している。このような圧電共振部品の構造例を図17に示す。

【0003】図17は圧電共振子と封止板の積層前の分解斜視図である。同図において21は圧電共振子、22、23はそれぞれその主面に形成された振動電極および引き出し電極が設置されている。24は封止板であり、圧電共振子21に面する側に凹部が形成されており、その凹部周辺部に樹脂層25を塗布し圧電共振子21と接着する。

【0004】図18(a)は圧電共振子21を2つの封止板24間に積層し、外部電極を形成した状態を表している。また図18(b)は図18(a)にA-A面における部分断面図である。このように封止板24の凹部と樹脂層25によって圧電共振子21上の振動電極22による振動を阻害しないように空間を確保している。

【0005】

【発明が解決しようとする課題】しかしながら従来の圧電共振部品は、封止板24と圧電共振子21を樹脂層25で接着しているため、実使用環境内の温度変化(-40°C から 85°C)により封止板24と圧電共振子21の接着性が低下し、振動空間の密封性を低下させるという欠点がある。

【0006】また、本硬化させる工程で熱や圧力がかかることにより、樹脂層25が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという欠点もある。

【0007】本発明は、このような従来の方法の課題を考慮し、安定した振動空間と良好な密封性が得られ、かつ樹脂層のしみ出しによる圧電共振子の特性劣化を防ぐことが出来る圧電共振部品とその製造方法を提供することを目的としている。

【0008】

【課題を解決するための手段】本発明は、振動励振用の振動電極と引き出し電極が2つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも2枚の封止板で挟み込んで積層して構成した圧電共振部品において、前記封止板と前記圧電共振子の間に、ガラス転移温度が 100°C 以上である熱硬化性樹脂を主成分とする樹脂層を介在させることによって、前記振動電極近傍領域に振動空間が形成されていることを特徴とする圧電共振部品である。

【0009】

【発明の実施の形態】以下、本発明の実施の形態について図1から図5を用いて説明する。

【0010】(実施の形態1)本発明の圧電共振部品に関する第1の形態について、図1及び図2を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、5は圧電共振子1の振動

空間を形成した樹脂層、6は外部電極である。

【0011】図1は本発明の請求項1及び請求項2に記載の圧電共振部品の切り欠き斜視図である。図2(a)は圧電共振部品の斜視図であり、図2(b)は図2

(a)のA-A面での部分断面図である。圧電共振子は例えばPZT等の圧電セラミック材料からなり、振動電極2と引き出し電極3はスパッタリング法などの乾式成膜法により形成する。振動電極2に外部から電圧を印加すると振動電極2の近傍のみが振動する振動モードが励振される。圧電共振子1と封止板4との間には樹脂層5が設置されており、圧電共振子1の振動を阻害しないように振動空間を形成している。封止板4は、アルミナや誘電体セラミックもしくは樹脂などの材料からなる。樹脂層5は、ガラス転移温度が100℃以上の例えば、エポキシなどの熱硬化性樹脂を主成分としている。しかし、必要に応じて熱可塑性樹脂やフィラー状のガラスなどを副成分として添加する場合もあるが、その添加量及び種類は樹脂混合物としてのガラス転移温度が100℃以上になるように調整したものである。尚、樹脂層5を構成する熱硬化性樹脂のガラス転移温度は、TMA法などの熱分析法を用い求めるものである。引き出し電極3は、図2(b)のBで示した2箇所での端面において外部電極6と電気的に接続されている。外部電極6は、めっき法等の湿式成膜法もしくはスパッタリング法などの乾式成膜法により形成する。本発明は、上述した構成により、実使用環境内の温度変化(-40℃から85℃)においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層5の厚みは、10μmより薄いと密封性が低下し、100μm以上の場合には外部電極との密着性が低下するため、10μm以上100μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0012】(実施の形態2)次に本発明の圧電共振部品の製造方法に関する第2の形態について、図3を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、5は圧電共振子1の振動空間を形成した樹脂層である。まず、図3(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図3(b)に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板4の表面に、圧電共振子の振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。この樹脂は、硬化後のガラス転移温度が100℃以上の主成分が熱硬化性樹脂を用いる。尚、ガラス転移温度は、樹脂を硬化させた後、TMA法により求めたものである。次に、樹脂層5を形成した封

止板4を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は60%以下が望ましい。次に、図3(c)に示すように、樹脂層5を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板を載置して挟持し、1~10kg/cm²の加圧下で、150℃1時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第2の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が100℃以上の樹脂により封止板と圧電共振子を接着しているため、実使用環境内の温度変化(-40℃から85℃)においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層の厚みは、10μmより薄いと密封性が低下し、100μm以上の場合には外部電極との密着性が低下するため、10μm以上100μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0013】(実施の形態3)次に本発明の圧電共振部品の製造方法に関する第3の形態について、図4を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、5は圧電共振子1の振動空間を形成した樹脂層である。まず、図4(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図4(b)に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に圧電共振子の残り主面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、硬化後のガラス転移温度が100℃以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、ガラス転移温度は、樹脂を硬化させた後、TMA法により求めたものである。次に、樹脂層5を形成した圧電共振子を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は60%以下が望ましい。次に、図4(c)に示すように、樹脂層を形成した圧電共振子の両面上に封止板を載置して挟持し、1~10kg/cm²の加圧下で、150℃1時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電

解めつき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第3の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が100℃以上の樹脂により封止板と圧電共振子を接着しているため、実使用環境内の温度変化（-40℃から85℃）においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層5の厚みは、10μmより薄いと密封性が低下し、100μm以上の場合には外部電極との密着性が低下するため、10μm以上100μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0014】（実施の形態4）次に本発明の圧電共振部品の製造方法に関する第3の形態について、図5を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、5は圧電共振子1の振動空間を形成した樹脂層である。まず、図5（a）に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図5（b）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に図5（c）に示すように、封止板の片面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、硬化後のガラス転移温度が100℃以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、ガラス転移温度は、樹脂を硬化させた後、TMA法により求めたものである。次に、樹脂層を形成した圧電共振子と封止板を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は60%以下が望ましい。次に、図5（d）に示すように、樹脂層5を形成した封止板上に圧電共振子を樹脂層5が形成された面を上にして載置しさらにその上から他方の封止板4を載置して挟持し、1~10kg/cm²の加圧下で、150℃1時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めつき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第4の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が100℃以上の樹脂により封止板4と圧電共振子1を接着しているため、実使用環境内の温度変化（-40℃から85℃）においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層5の厚みは、1

0μmより薄いと密封性が低下し、100μm以上の場合には外部電極との密着性が低下するため、10μm以上100μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0015】（実施の形態5）次に本発明の圧電共振部品の製造方法に関する第5の形態について、図6を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、7は圧電共振子1の振動空間を形成した樹脂フィルム層である。まず、図6（a）に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図6（b）に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板4の表面に、圧電共振子の振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層7を形成する。この樹脂フィルムは、硬化後のガラス転移温度が100℃以上の主成分が熱硬化性樹脂により構成されている。尚、ガラス転移温度は、樹脂を硬化させた後、TMA法により求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度+30℃の範囲の温度で1~5kg/cm²の圧力でラミネートすることが望ましい。次に、図6（c）に示すように、樹脂フィルム層7を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板4を載置して挟持し、1~10kg/cm²の加圧下で、150℃1時間加熱し、樹脂フィルムを本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めつき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第5の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が100℃以上の樹脂フィルムにより封止板と圧電共振子を接着しているため、実使用環境内の温度変化（-40℃から85℃）においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂フィルムの厚みは、10μmより薄いと密封性が低下し、100μm以上の場合には外部電極との密着性が低下するため、10μm以上100μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0016】（実施の形態6）次に本発明の圧電共振部品の製造方法に関する第6の形態について、図7を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、7は圧電共振子1

の振動空間を形成した樹脂フィルム層である。まず、図7(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図7(b)に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層7を形成する。次に圧電共振子の残り主面に振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層を形成する。この樹脂フィルムは、硬化後のガラス転移温度が100℃以上の主成分が熱硬化性樹脂により構成されている。尚、ガラス転移温度は、樹脂を硬化させた後、TMA法により求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度+30℃の範囲の温度で1~5kg/cm²の圧力でラミネートすることが望ましい。次に、図7(c)に示すように、樹脂フィルム層7を形成した圧電共振子の両面上に封止板を載置して挟持し、1~10kg/cm²の加圧下で、150℃1時間加熱し、樹脂フィルムを本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第6の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が100℃以上の樹脂フィルムにより封止板と圧電共振子を接着しているため、実使用環境内の温度変化(−40℃から85℃)においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂フィルムの厚みは、10μmより薄いと密封性が低下し、100μm以上の場合には外部電極との密着性が低下するため、10μm以上100μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0017】(実施の形態7)次に本発明の圧電共振部品の製造方法に関する第7の形態について、図8を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、7は圧電共振子1の振動空間を形成した樹脂フィルム層である。まず、図8(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図8(b)に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層を形成する。次に図8(c)に示すように、封止板の片面に振動電極近傍領域を除いて、未硬

化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層7を形成する。この樹脂フィルムは、硬化後のガラス転移温度が100℃以上の主成分が熱硬化性樹脂により構成されている。尚、ガラス転移温度は、樹脂を硬化させた後、TMA法により求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度+30℃の範囲の温度で1~5kg/cm²の圧力でラミネートすることが望ましい。次に、図8(d)に示すように、樹脂フィルム層を形成した封止板上に圧電共振子を樹脂フィルム層が形成された面を上にして載置しさらにその上から他方の封止板を載置して挟持し、1~10kg/cm²の加圧下で、150℃1時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第7の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が100℃以上の樹脂フィルムにより封止板と圧電共振子を接着しているため、実使用環境内の温度変化(−40℃から85℃)においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂フィルムの厚みは、10μmより薄いと密封性が低下し、100μm以上の場合には外部電極との密着性が低下するため、10μm以上100μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0018】(実施の形態8)本発明の圧電共振部品に関する第8の形態について、図9及び図10を用いて説明する。同図において11は圧電共振子、12は振動電極、13は引き出し電極、14は封止板、15は圧電共振子11の振動空間を形成した樹脂層、16は外部電極である。図9は本発明の圧電共振部品の切り欠き斜視図である。図10(a)は圧電共振部品の斜視図であり、図10(b)は図10(a)のA-A面での部分断面図である。圧電共振子は例えばPZT等の圧電セラミック材料からなり、振動電極12と引き出し電極13はスパッタリング法などの乾式成膜法により形成する。振動電極12に外部から電圧を印加すると振動電極12の近傍のみが振動する振動モードが励振される。圧電共振子11と封止板14との間には樹脂層15が設置されており、圧電共振子11の振動を阻害しないように振動空間を形成している。封止板14は、アルミナや誘電体セラミックもしくは樹脂などの材料からなる。樹脂層15は、加熱硬化時の最低溶融粘度が20Pa・s以上の例え、エポキシなどの熱硬化性樹脂を主成分としている。しかし、必要に応じて熱可塑性樹脂やフィラー状のガラスなどを副成分として添加する場合もあるが、その

添加量及び種類は樹脂混合物としての加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上になるように調整したものである。尚、樹脂層15を構成する熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めるものである。引き出し電極13は、図10(b)のBで示した2箇所での端面において外部電極16と電気的に接続されている。外部電極16は、めっき法等の湿式成膜法もしくはスパッタリング法などの乾式成膜法により形成する。本発明は、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、 $10\mu\text{m}$ より薄いと密封性が低下し、 $100\mu\text{m}$ 以上の場合には外部電極との密着性が低下するため、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下が望ましい。尚、本実施の形態8では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0019】(実施の形態9)次に本発明の圧電共振部品の製造方法に関する第9の形態について、図11を用いて説明する。同図において11は圧電共振子、12は振動電極、13は引き出し電極、14は封止板、15は圧電共振子11の振動空間を形成した樹脂層である。まず、図11(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極12と引き出し電極13はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図11(b)に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板14の表面に、圧電共振子の振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層15を形成する。この樹脂は、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。次に、樹脂層を形成した封止板を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は60%以下が望ましい。次に、図11(c)に示すように、樹脂層を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板を載置して挟持し、 $1\sim 10\text{kg}/\text{cm}^2$ の加圧下で、 150°C 1時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、 $10\text{kg}/\text{cm}^2$ より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第10の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振

電極を形成する。上記第9の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、 $10\mu\text{m}$ より薄いと密封性が低下し、 $100\mu\text{m}$ 以上の場合には外部電極との密着性が低下するため、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下が望ましい。尚、本実施の形態9では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0020】(実施の形態10)次に本発明の圧電共振部品の製造方法に関する第10の形態について、図12を用いて説明する。同図において11は圧電共振子、12は振動電極、13は引き出し電極、14は封止板、15は圧電共振子11の振動空間を形成した樹脂層である。まず、図12(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極12と引き出し電極13はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図12(b)に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層15を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に圧電共振子の残り主面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層15を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。次に、樹脂層を形成した圧電共振子を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は60%以下が望ましい。次に、図12(c)に示すように、樹脂層を形成した圧電共振子の両面上に封止板を載置して挟持し、 $1\sim 10\text{kg}/\text{cm}^2$ の加圧下で、 150°C 1時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、 $10\text{kg}/\text{cm}^2$ より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第10の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振

子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、 $10\mu\text{m}$ より薄いと密封性が低下し、 $100\mu\text{m}$ 以上の場合外部電極との密着性が低下するため、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下が望ましい。尚、本実施の形態10では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0021】(実施の形態11)次に本発明の圧電共振部品の製造方法に関する第11の形態について、図13を用いて説明する。同図において11は圧電共振子、12は振動電極、13は引き出し電極、14は封止板、15は圧電共振子11の振動空間を形成した樹脂層である。まず、図13(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図13(b)に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層15を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に図13(c)に示すように、封止板の片面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層15を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、加熱硬化時の最低熔融粘度が $20\text{Pa}\cdot\text{s}$ 以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低熔融粘度は、レオメーターを用い求めたものである。次に、樹脂層を形成した圧電共振子と封止板を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は60%以下が望ましい。次に、図13(d)に示すように、樹脂層を形成した封止板上に圧電共振子を樹脂層が形成された面を上にして載置しさらにその上から他方の封止板を載置して挟持し、 $1\sim 10\text{kg}/\text{cm}^2$ の加圧下で、 150°C 1時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、 $10\text{kg}/\text{cm}^2$ より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低熔融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第11の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、 $10\mu\text{m}$ より

薄いと密封性が低下し、 $100\mu\text{m}$ 以上の場合外部電極との密着性が低下するため、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下が望ましい。尚、本実施の形態11では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0022】(実施の形態12)次に本発明の圧電共振部品の製造方法に関する第12の形態について、図14を用いて説明する。同図において11は圧電共振子、12は振動電極、13は引き出し電極、14は封止板、17は圧電共振子11の振動空間を形成した樹脂フィルム層である。まず、図14(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極12と引き出し電極13はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図14(b)に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板14の表面に、圧電共振子の振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層17を形成する。この樹脂フィルムは、加熱硬化時の最低熔融粘度が $20\text{Pa}\cdot\text{s}$ 以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低熔融粘度は、レオメーターを用い求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度 $+30^\circ\text{C}$ の範囲の温度で $1\sim 5\text{kg}/\text{cm}^2$ の圧力でラミネートすることが望ましい。次に、図14(c)に示すように、樹脂フィルム層を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板を載置して挟持し、 $1\sim 10\text{kg}/\text{cm}^2$ の加圧下で、 150°C 1時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、 $10\text{kg}/\text{cm}^2$ より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低熔融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第12の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂フィルムの厚みは、 $10\mu\text{m}$ より薄いと密封性が低下し、 $100\mu\text{m}$ 以上 $100\mu\text{m}$ 以下が望ましい。尚、本実施の形態12では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合に

においても同様な効果がある。

【0023】(実施の形態13)次に本発明の圧電共振部品の製造方法に関する第13の形態について、図15を用いて説明する。同図において11は圧電共振子、12は振動電極、13は引き出し電極、14は封止板、17は圧電共振子11の振動空間を形成した樹脂フィルム層である。まず、図15(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極12と引き出し電極13はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図15(b)に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層17を形成する。次に圧電共振子の残り主面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層17を形成する。この樹脂フィルムは、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度 $+30^\circ\text{C}$ の範囲の温度で $1\sim 5\text{kg}/\text{cm}^2$ の圧力でラミネートすることが望ましい。次に、図15(c)に示すように、樹脂フィルム層を形成した圧電共振子の両面上に封止板を載置して挟持し、 $1\sim 10\text{kg}/\text{cm}^2$ の加圧下で、 150°C 1時間加熱し、樹脂フィルムを本硬化させ一体化する。本硬化時の加圧が、 $10\text{kg}/\text{cm}^2$ より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第13の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂フィルムの厚みは、 $10\mu\text{m}$ より薄いと密封性が低下し、 $100\mu\text{m}$ 以上の場合には外部電極との密着性が低下するため、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下が望ましい。尚、本実施の形態13では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0024】(実施の形態14)次に本発明の圧電共振部品の製造方法に関する第7の形態について、図16を用いて説明する。同図において11は圧電共振子、12

は振動電極、13は引き出し電極、14は封止板、17は圧電共振子11の振動空間を形成した樹脂フィルム層である。まず、図16(a)に示すように、例えばPZT等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図16(b)に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層17を形成する。次に図16(c)に示すように、封止板の片面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層17を形成する。この樹脂フィルムは、加熱硬化時の最低溶融粘度が $20\text{Pa}\cdot\text{s}$ 以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度 $+30^\circ\text{C}$ の範囲の温度で $1\sim 5\text{kg}/\text{cm}^2$ の圧力でラミネートすることが望ましい。次に、図16(d)に示すように、樹脂フィルム層を形成した封止板上に圧電共振子を樹脂フィルム層が形成された面を上にして載置しさらにその上から他方の封止板を載置して挟持し、 $1\sim 10\text{kg}/\text{cm}^2$ の加圧下で、 150°C 1時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、 $10\text{kg}/\text{cm}^2$ より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第14の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂フィルムの厚みは、 $10\mu\text{m}$ より薄いと密封性が低下し、 $100\mu\text{m}$ 以上の場合には外部電極との密着性が低下するため、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下が望ましい。尚、本実施の形態14では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0025】なお、以上述べた本発明の実施の形態の効果を確認するため、ガラス転移温度を色々異ならせて作成したものについて、密封性を実験したところ、表1の結果が得られた。

【0026】

【表1】

ガラス転移温度 (℃)	50	70	90	105	125	140
密封性	NG	NG	NG	G	G	G

【0027】表1から明らかなように、ガラス転移温度100℃以上の場合が密封性が高いことが分かる。

【0028】また、最低溶融粘度を色々異ならせて作成したものについて、その浸みだし係数を測定したところ、

表2のような結果が得られた。

【0029】

【表2】

最低溶融粘度 (Pa・s)	5	10	20	30	50	100
浸みだし係数 注(1)	>10	>10	<3	<2	<2	<2
判定	NG	NG	G	G	G	G

注(1) 浸みだし係数=浸みだし幅÷樹脂層厚み

【0030】表2から明らかなように、最低溶融粘度が20以上の場合、浸みだし係数が良い結果を示すことがわかる。なお、この浸みだし係数とは、浸みだし係数=(浸みだし幅)/(樹脂厚さ)で表され、その浸みだし幅と、樹脂厚さは図19に示すような条件で定義される量である。

【0031】

【発明の効果】以上のように本発明によれば、ガラス転移温度が100℃以上の樹脂もしくは樹脂フィルムにより封止板と圧電共振子を接着しているため、実使用環境内の温度変化(-40℃から85℃)においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。

【0032】また、加熱硬化時の最低溶融粘度が20 Pa・s以上の樹脂もしくは樹脂フィルムにより封止板と圧電共振子を接着しているため、本硬化させる工程で熱や圧力がかかることにより、樹脂層15が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。

【図面の簡単な説明】

【図1】本発明の実施の形態1における圧電共振部品の切り欠き斜視図

【図2】(a)は同実施の形態1における圧電共振部品の斜視図、(b)は図2(a)のA-A面での部分断面図

【図3】本発明の実施の形態2における圧電共振部品の積層前の分解斜視図

【図4】本発明の実施の形態3における圧電共振部品の積層前の分解斜視図

【図5】本発明の実施の形態4における圧電共振部品の積層前の分解斜視図

【図6】本発明の実施の形態5における圧電共振部品の

積層前の分解斜視図

【図7】本発明の実施の形態6における圧電共振部品の積層前の分解斜視図

【図8】本発明の実施の形態7における圧電共振部品の積層前の分解斜視図

【図9】本発明の実施の形態8における圧電共振部品の切り欠き斜視図

【図10】(a)は同実施の形態8における圧電共振部品の斜視図、(b)は図10(a)のA-A面での部分断面図

【図11】本発明の実施の形態9における圧電共振部品の積層前の分解斜視図

【図12】本発明の実施の形態10における圧電共振部品の積層前の分解斜視図

【図13】本発明の実施の形態11における圧電共振部品の積層前の分解斜視図

【図14】本発明の実施の形態12における圧電共振部品の積層前の分解斜視図

【図15】本発明の実施の形態13における圧電共振部品の積層前の分解斜視図

【図16】本発明の実施の形態14における圧電共振部品の積層前の分解斜視図

【図17】従来の圧電共振部品の積層前の分解斜視図

【図18】(a)は従来の圧電共振部品の斜視図、(b)は図18(a)のA-A面での部分断面図

【図19】本発明の実施の形態における最低溶融粘度の効果を確かめる場合に用いられる浸みだし係数を示す図面

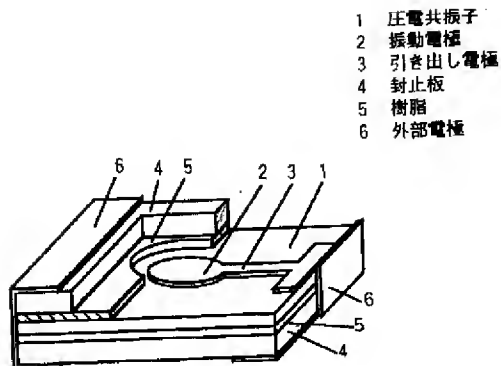
(符号の説明)

- 1 圧電共振子
- 2 振動電極
- 3 引き出し電極
- 4 封止板
- 5 樹脂層

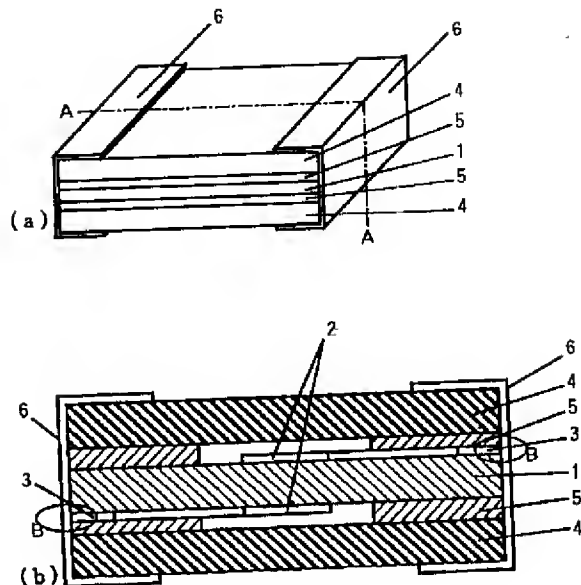
- 6 外部電極
- 11 圧電共振子
- 12 振動電極
- 13 引き出し電極
- 14 封止板
- 15 樹脂層
- 16 外部電極

- 17 樹脂フィルム層
- 21 圧電共振子
- 22 振動電極
- 23 引き出し電極
- 24 封止板
- 25 樹脂
- 26 外部電極

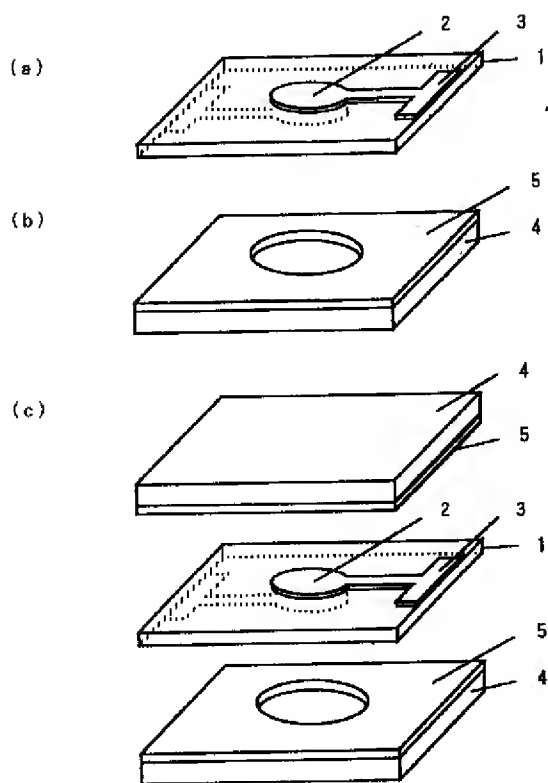
【図1】



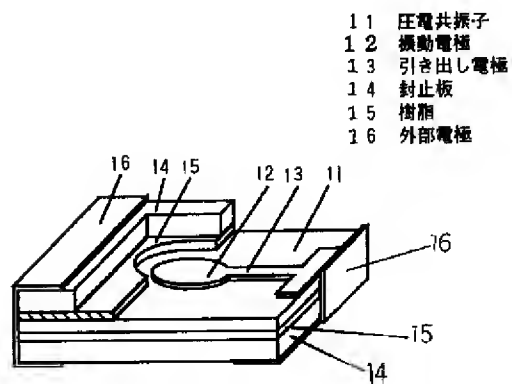
【図2】



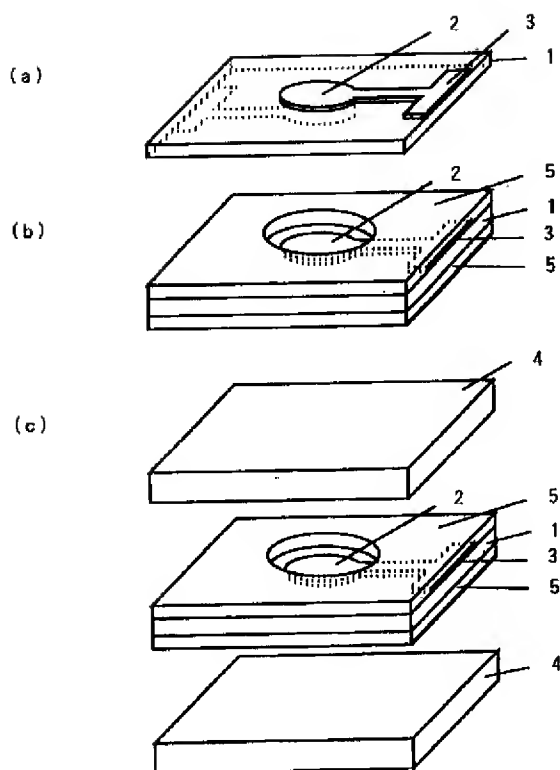
【図3】



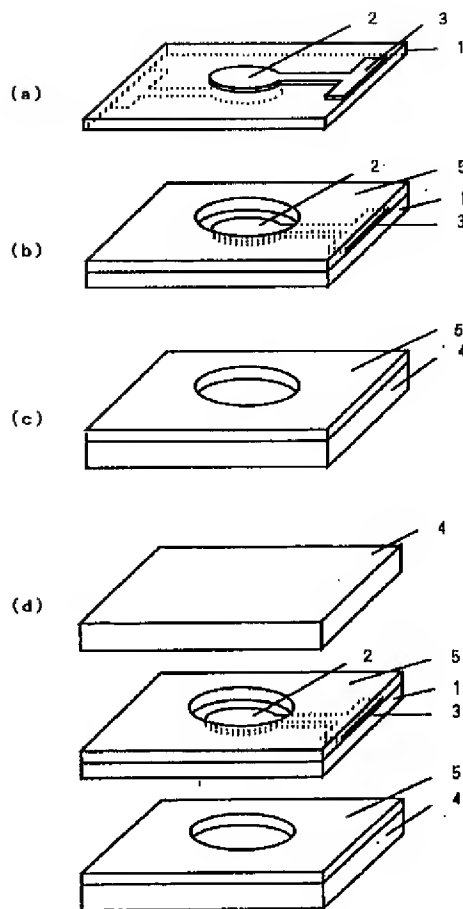
【図9】



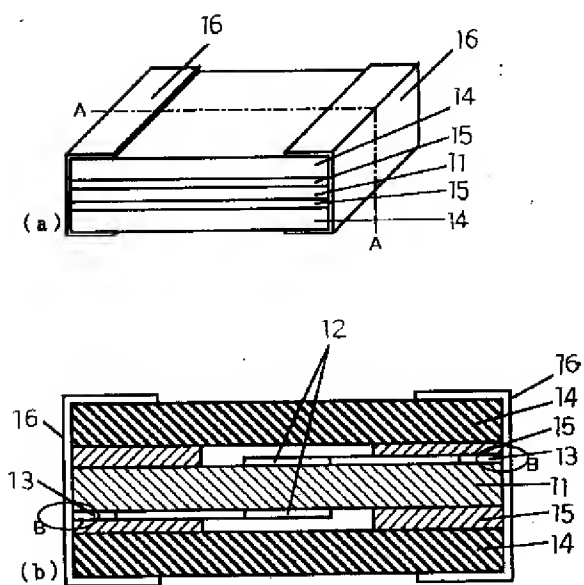
【図4】



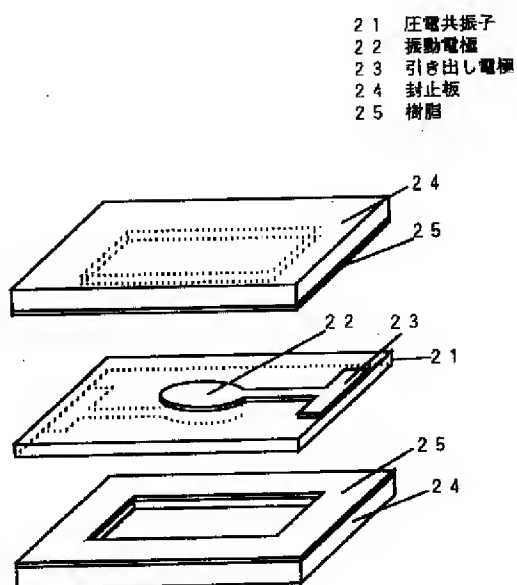
【図5】



【図10】

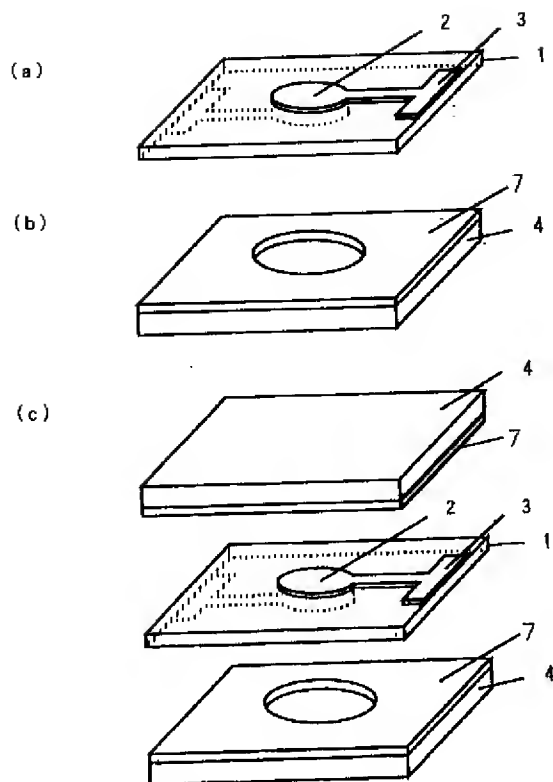


【図17】

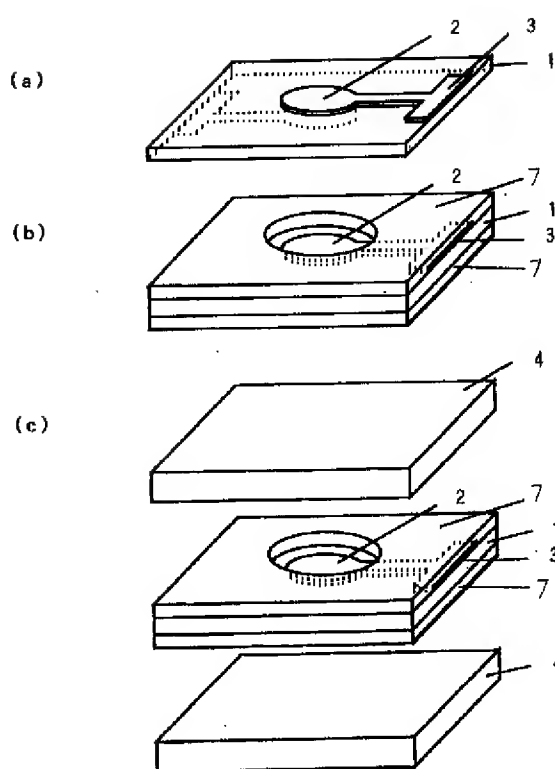


- 2 1 圧電共振子
- 2 2 振動電極
- 2 3 引き出し電極
- 2 4 封止板
- 2 5 樹脂

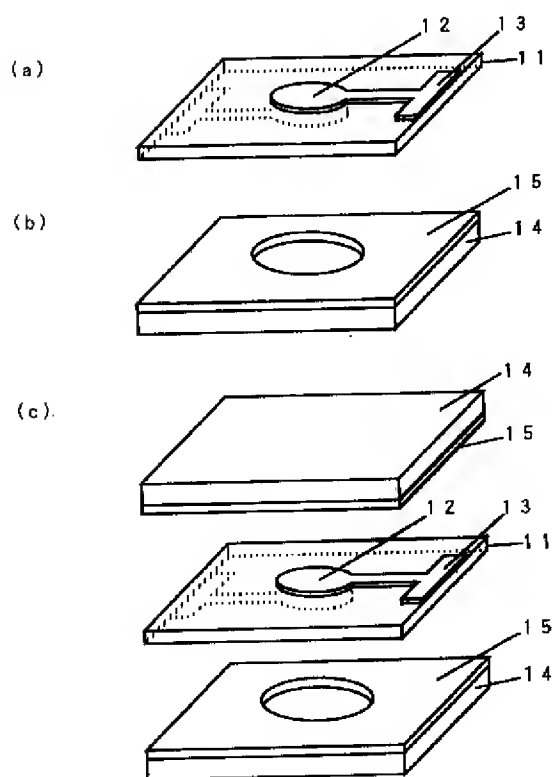
【図6】



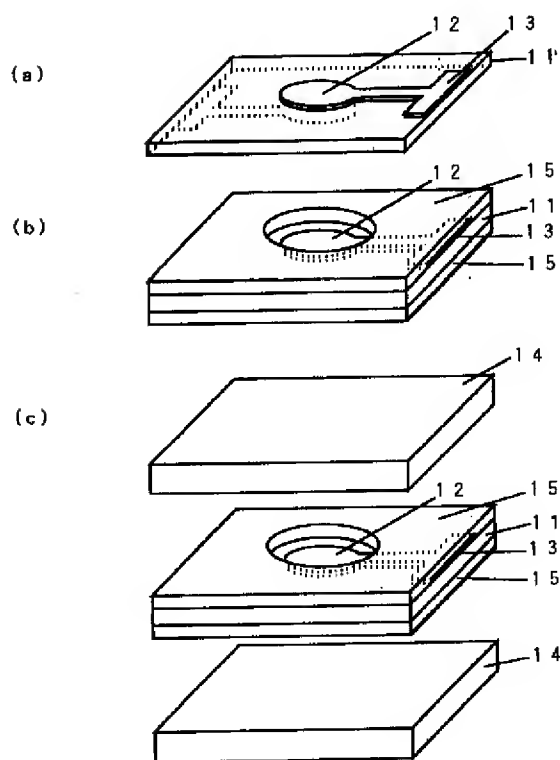
【図7】



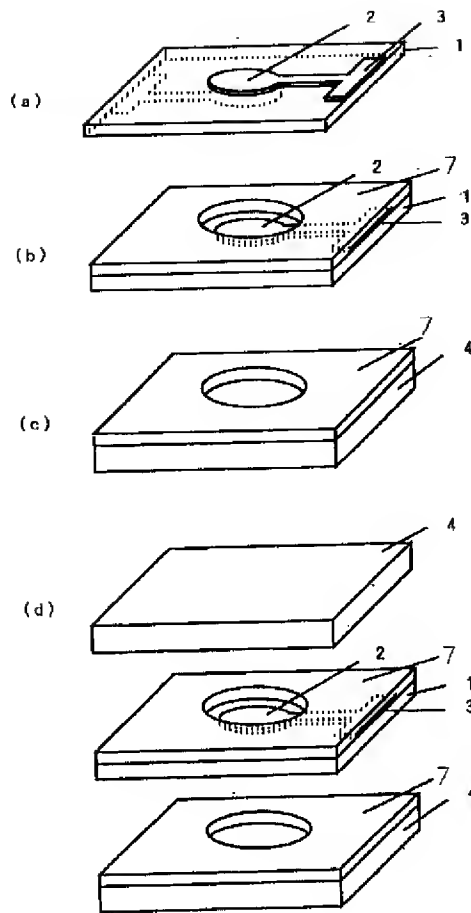
【図11】



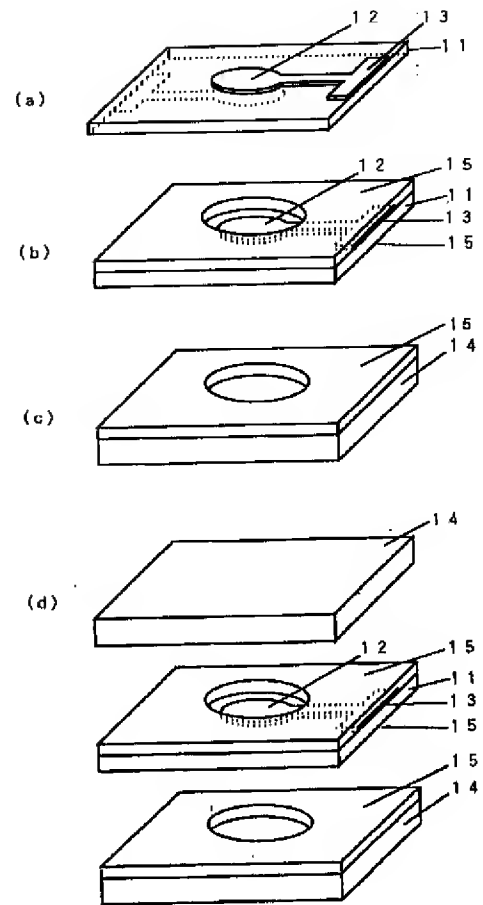
【図12】



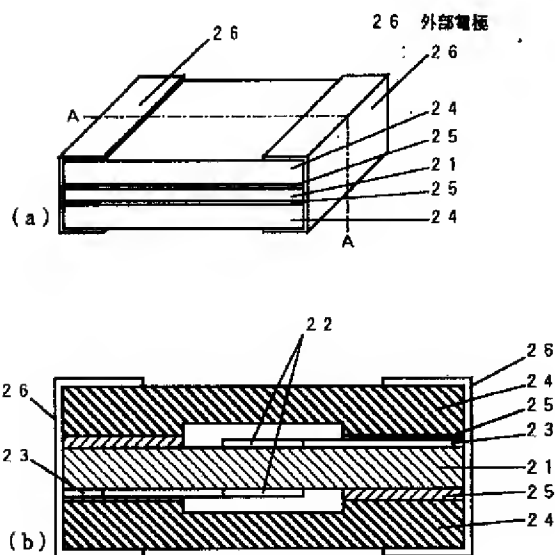
【図8】



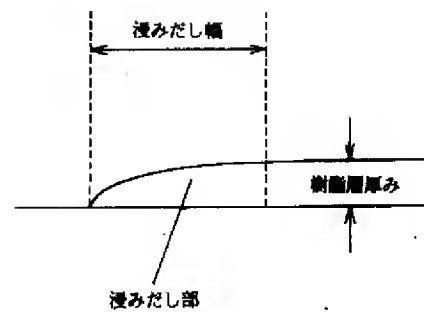
【図13】



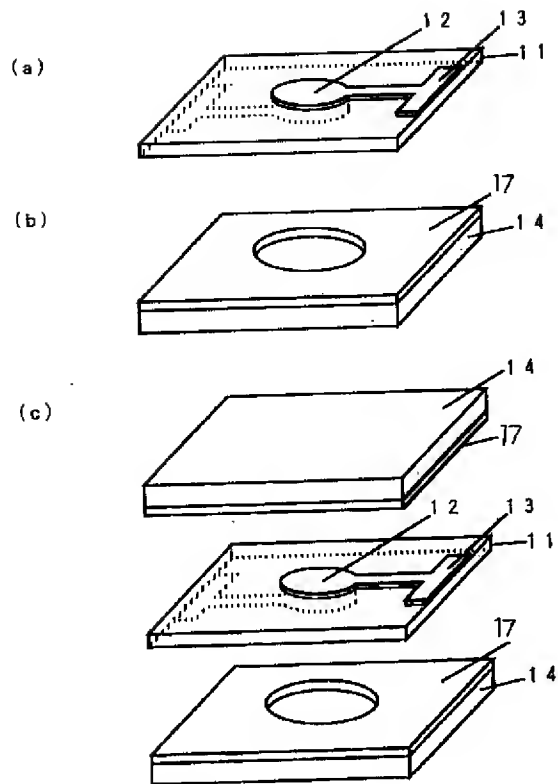
【図18】



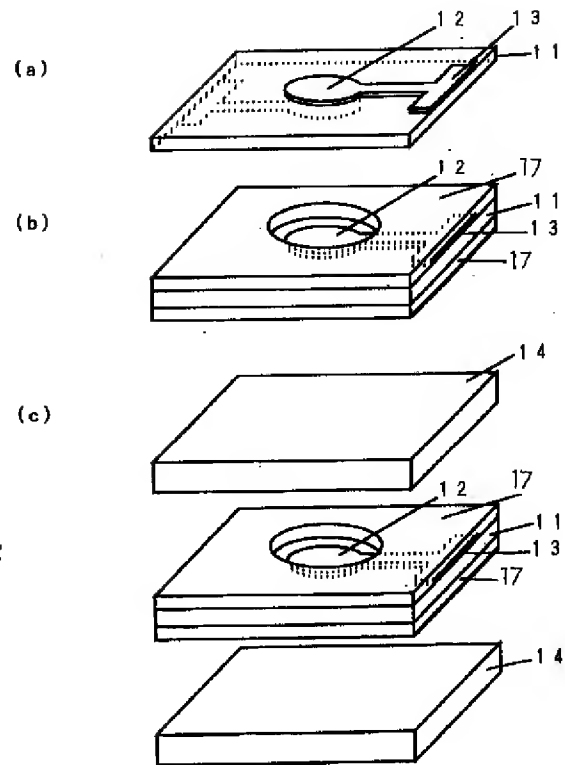
【図19】



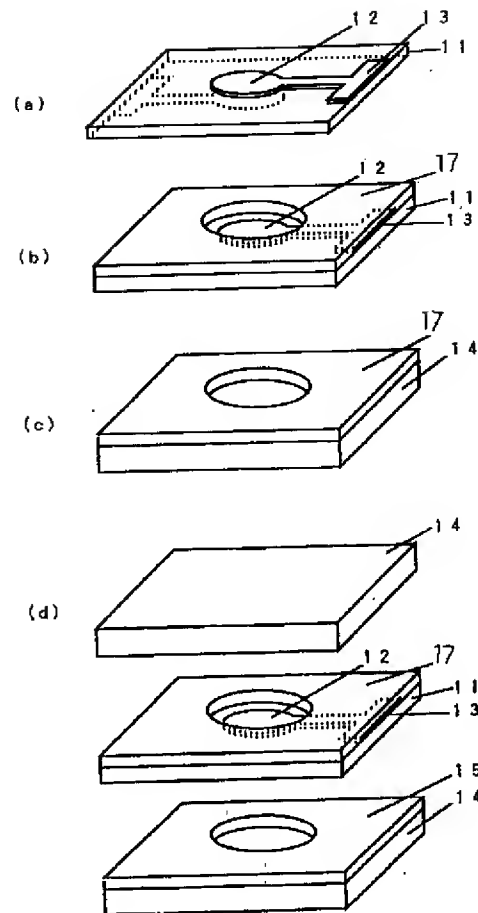
【図14】



【図15】



【図16】



フロントページの続き

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